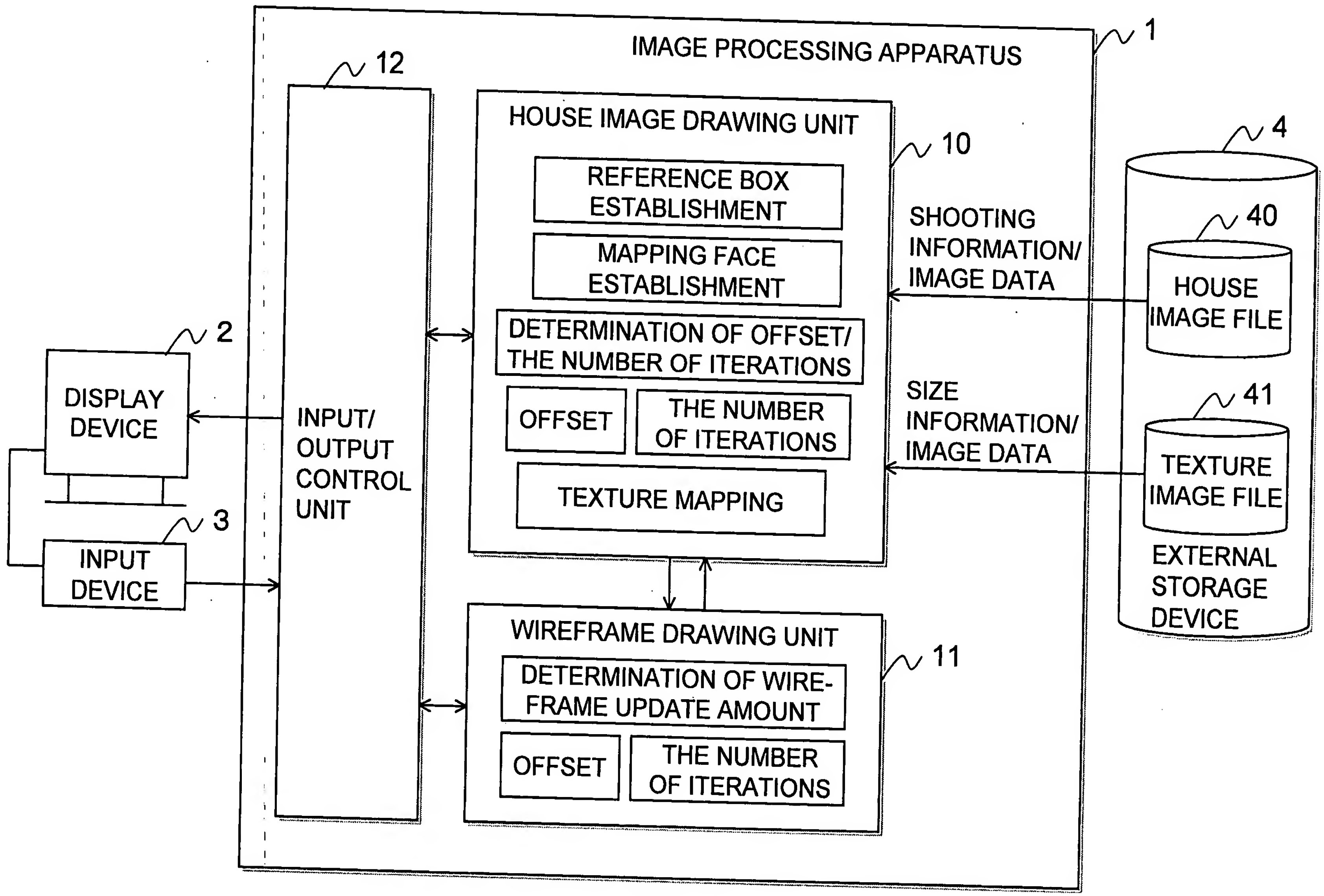

1
IMAGE PROCESSING APPARATUS
12
INPUT/
OUTPUT
CONTROL
UNIT
HOUSE IMAGE DRAWING UNIT
10
REFERENCE BOX
ESTABLISHMENT
MAPPING FACE
ESTABLISHMENT
DETERMINATION OF OFFSET/
THE NUMBER OF ITERATIONS
OFFSET
THE NUMBER
OF ITERATIONS
TEXTURE MAPPING
WIREFRAME DRAWING UNIT
11
DETERMINATION OF WIRE-
FRAME UPDATE AMOUNT
OFFSET
THE NUMBER
OF ITERATIONS
2
DISPLAY
DEVICE
3
INPUT
DEVICE
SHOOTING
INFORMATION/
IMAGE DATA
SIZE
INFORMATION/
IMAGE DATA
4
40
HOUSE
IMAGE FILE
41
TEXTURE
IMAGE FILE
EXTERNAL
STORAGE
DEVICE

FIG. 1

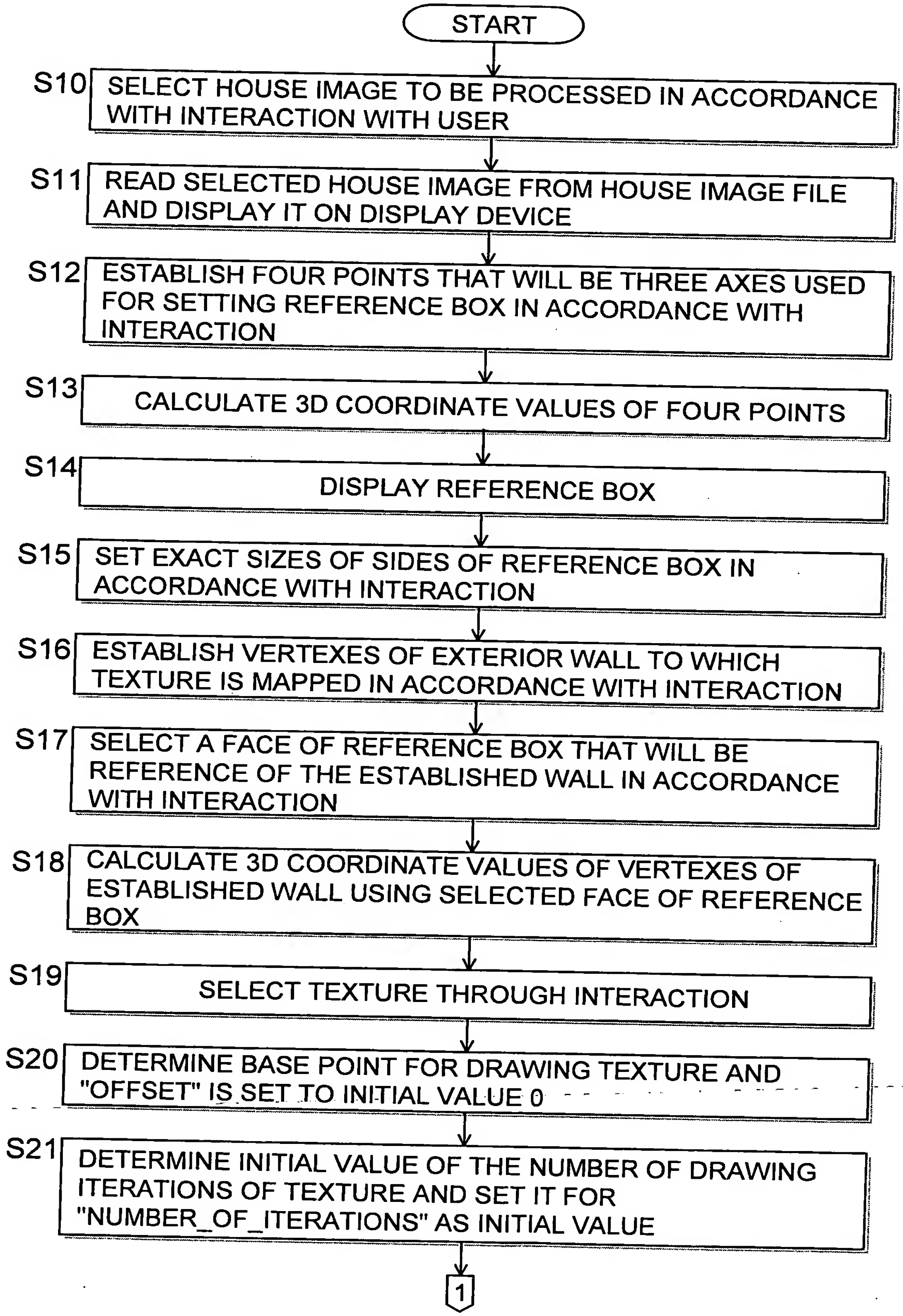

START
S10
SELECT HOUSE IMAGE TO BE PROCESSED IN ACCORDANCE WITH INTERACTION WITH USER
S11
READ SELECTED HOUSE IMAGE FROM HOUSE IMAGE FILE AND DISPLAY IT ON DISPLAY DEVICE
S12
ESTABLISH FOUR POINTS THAT WILL BE THREE AXES USED FOR SETTING REFERENCE BOX IN ACCORDANCE WITH INTERACTION
S13
CALCULATE 3D COORDINATE VALUES OF FOUR POINTS
S14
DISPLAY REFERENCE BOX
S15
SET EXACT SIZES OF SIDES OF REFERENCE BOX IN ACCORDANCE WITH INTERACTION
S16
ESTABLISH VERTEXES OF EXTERIOR WALL TO WHICH TEXTURE IS MAPPED IN ACCORDANCE WITH INTERACTION
S17
SELECT A FACE OF REFERENCE BOX THAT WILL BE REFERENCE OF THE ESTABLISHED WALL IN ACCORDANCE WITH INTERACTION
S18
CALCULATE 3D COORDINATE VALUES OF VERTEXES OF ESTABLISHED WALL USING SELECTED FACE OF REFERENCE BOX
S19
SELECT TEXTURE THROUGH INTERACTION
S20
DETERMINE BASE POINT FOR DRAWING TEXTURE AND "OFFSET" IS SET TO INITIAL VALUE 0
S21
DETERMINE INITIAL VALUE OF THE NUMBER OF DRAWING ITERATIONS OF TEXTURE AND SET IT FOR "NUMBER_OF_ITERATIONS" AS INITIAL VALUE
1

FIG.2

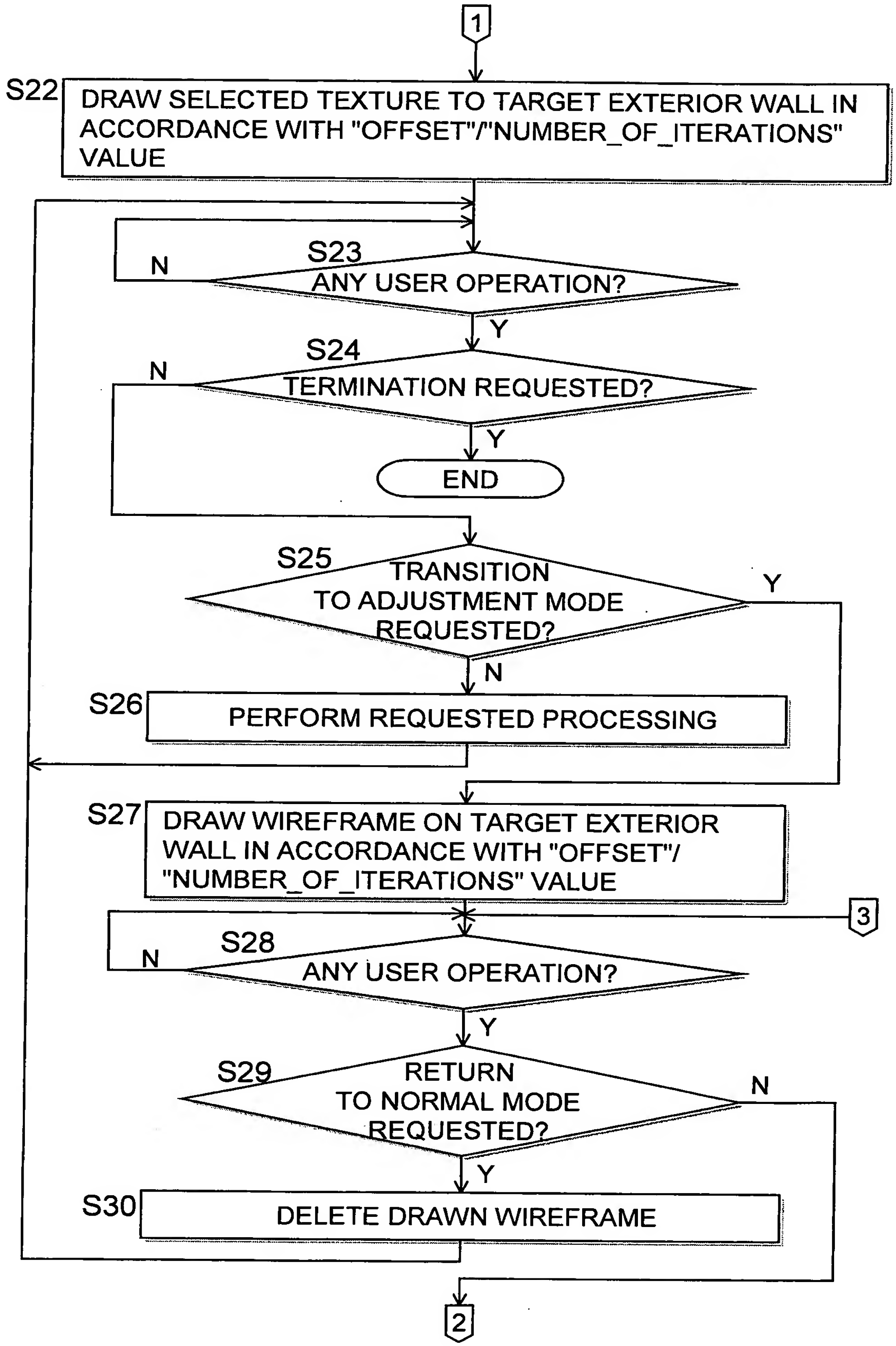

1
S22
DRAW SELECTED TEXTURE TO TARGET EXTERIOR WALL IN ACCORDANCE WITH "OFFSET"/"NUMBER_OF_ITERATIONS" VALUE
S23
ANY USER OPERATION?
N
Y
S24
TERMINATION REQUESTED?
N
Y
END
S25
TRANSITION TO ADJUSTMENT MODE REQUESTED?
Y
N
S26
PERFORM REQUESTED PROCESSING
S27
DRAW WIREFRAME ON TARGET EXTERIOR WALL IN ACCORDANCE WITH "OFFSET"/ "NUMBER_OF_ITERATIONS" VALUE
3
S28
ANY USER OPERATION?
N
Y
S29
RETURN TO NORMAL MODE REQUESTED?
N
Y
S30
DELETE DRAWN WIREFRAME
2

FIG.3

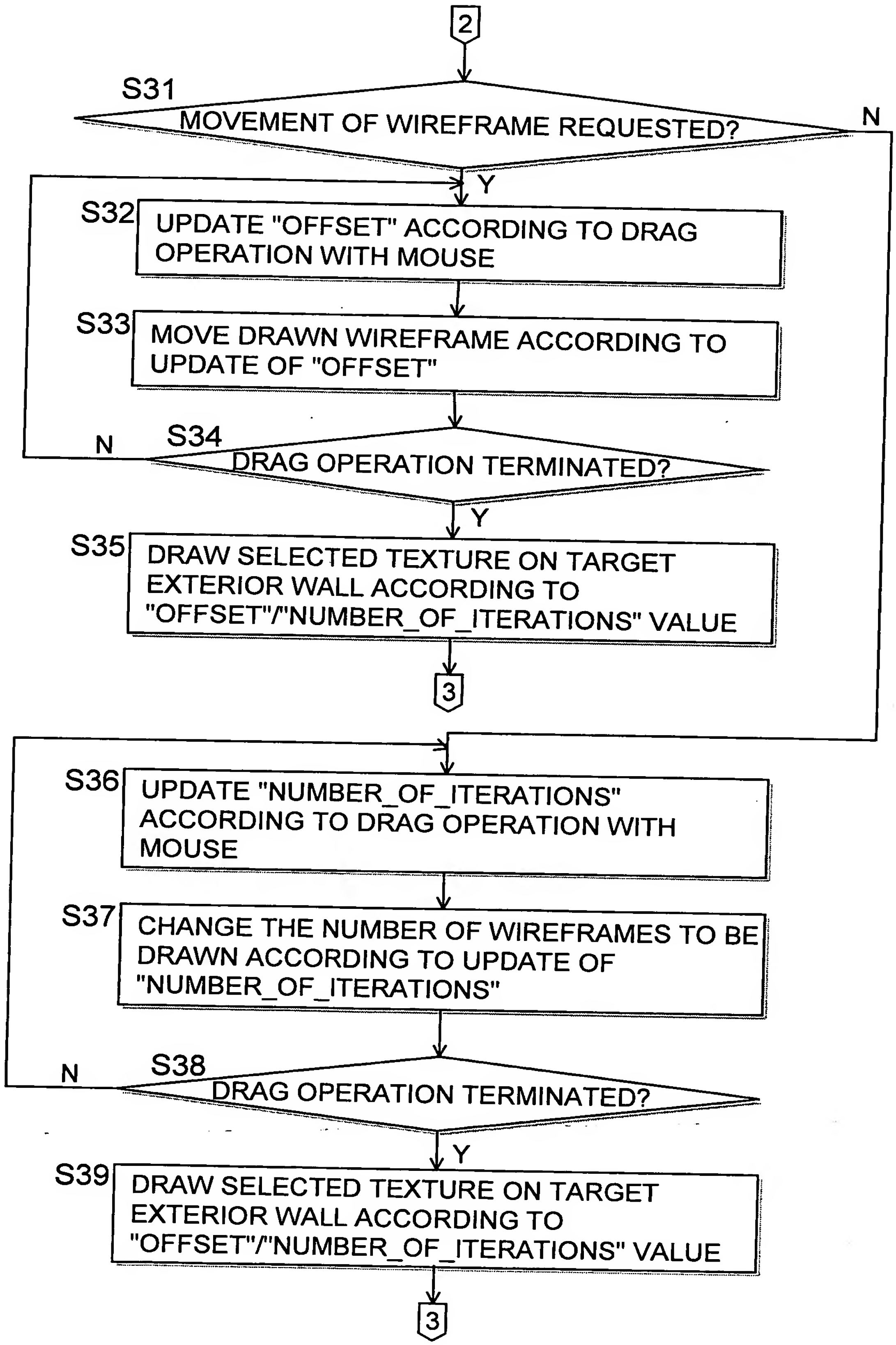

2
S31
MOVEMENT OF WIREFRAME REQUESTED?
N
Y
S32
UPDATE "OFFSET" ACCORDING TO DRAG OPERATION WITH MOUSE
S33
MOVE DRAWN WIREFRAME ACCORDING TO UPDATE OF "OFFSET"
N
S34
DRAG OPERATION TERMINATED?
Y
S35
DRAW SELECTED TEXTURE ON TARGET EXTERIOR WALL ACCORDING TO "OFFSET"/"NUMBER_OF_ITERATIONS" VALUE
3
S36
UPDATE "NUMBER_OF_ITERATIONS" ACCORDING TO DRAG OPERATION WITH MOUSE
S37
CHANGE THE NUMBER OF WIREFRAMES TO BE DRAWN ACCORDING TO UPDATE OF "NUMBER_OF_ITERATIONS"
N
S38
DRAG OPERATION TERMINATED?
Y
S39
DRAW SELECTED TEXTURE ON TARGET EXTERIOR WALL ACCORDING TO "OFFSET"/"NUMBER_OF_ITERATIONS" VALUE
3

FIG.4

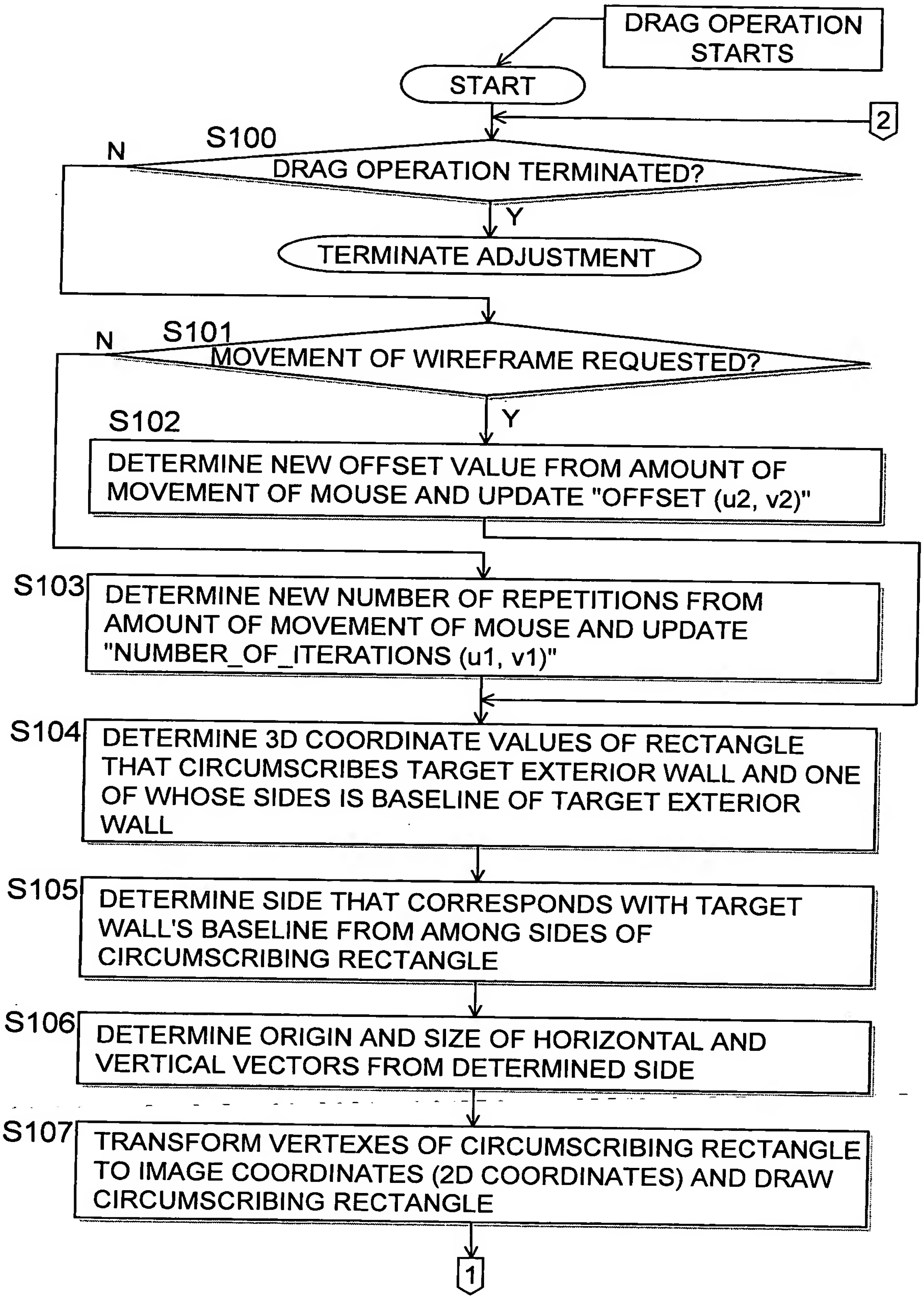

DRAG OPERATION STARTS
START
2
S100
DRAG OPERATION TERMINATED?
N
Y
TERMINATE ADJUSTMENT
S101
MOVEMENT OF WIREFRAME REQUESTED?
N
Y
S102
DETERMINE NEW OFFSET VALUE FROM AMOUNT OF MOVEMENT OF MOUSE AND UPDATE "OFFSET (u2, v2)"
S103
DETERMINE NEW NUMBER OF REPETITIONS FROM AMOUNT OF MOVEMENT OF MOUSE AND UPDATE "NUMBER_OF_ITERATIONS (u1, v1)"
S104
DETERMINE 3D COORDINATE VALUES OF RECTANGLE THAT CIRCUMSCRIBES TARGET EXTERIOR WALL AND ONE OF WHOSE SIDES IS BASELINE OF TARGET EXTERIOR WALL
S105
DETERMINE SIDE THAT CORRESPONDS WITH TARGET WALL'S BASELINE FROM AMONG SIDES OF CIRCUMSCRIBING RECTANGLE
S106
DETERMINE ORIGIN AND SIZE OF HORIZONTAL AND VERTICAL VECTORS FROM DETERMINED SIDE
S107
TRANSFORM VERTEXES OF CIRCUMSCRIBING RECTANGLE TO IMAGE COORDINATES (2D COORDINATES) AND DRAW CIRCUMSCRIBING RECTANGLE
1

FIG.5

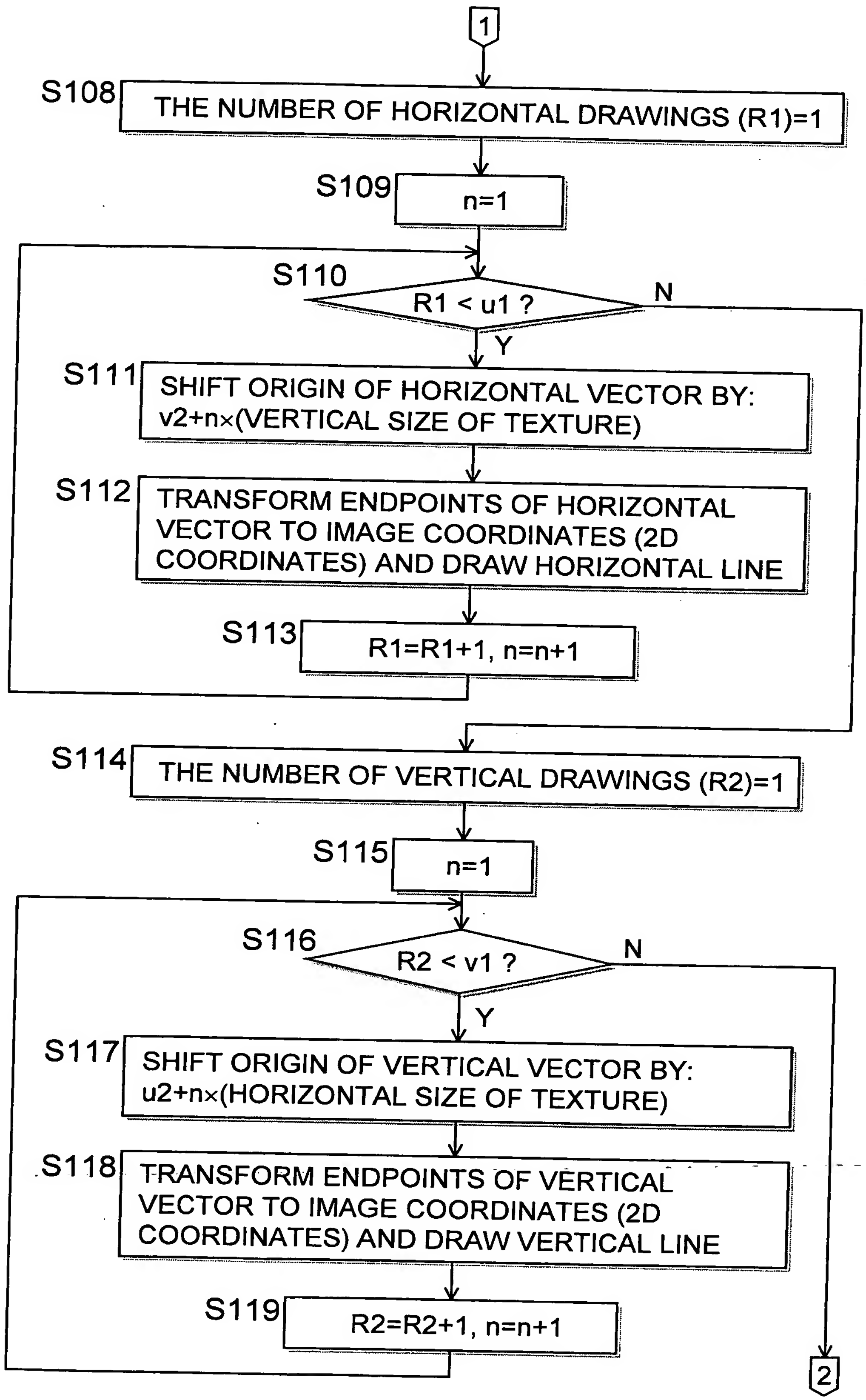

1
S108
THE NUMBER OF HORIZONTAL DRAWINGS (R1)=1
S109
n=1
S110
R1 < u1 ?
N
Y
S111
SHIFT ORIGIN OF HORIZONTAL VECTOR BY: v2+n×(VERTICAL SIZE OF TEXTURE)
S112
TRANSFORM ENDPOINTS OF HORIZONTAL VECTOR TO IMAGE COORDINATES (2D COORDINATES) AND DRAW HORIZONTAL LINE
S113
R1=R1+1, n=n+1
S114
THE NUMBER OF VERTICAL DRAWINGS (R2)=1
S115
n=1
S116
R2 < v1 ?
N
Y
S117
SHIFT ORIGIN OF VERTICAL VECTOR BY: u2+n×(HORIZONTAL SIZE OF TEXTURE)
S118
TRANSFORM ENDPOINTS OF VERTICAL VECTOR TO IMAGE COORDINATES (2D COORDINATES) AND DRAW VERTICAL LINE
S119
R2=R2+1, n=n+1
2

FIG.6


Reference Box Setting - Specify Width/Height/Depth
100%
Use elevation image
Next
Cancel
A reference box for changing walls and positioning members is set. Three sides (width, height, and depth) that meet at a corner of a rectangular solid in the image are set. Designate the first point (a corner of the rectangular solid).

FIG.7

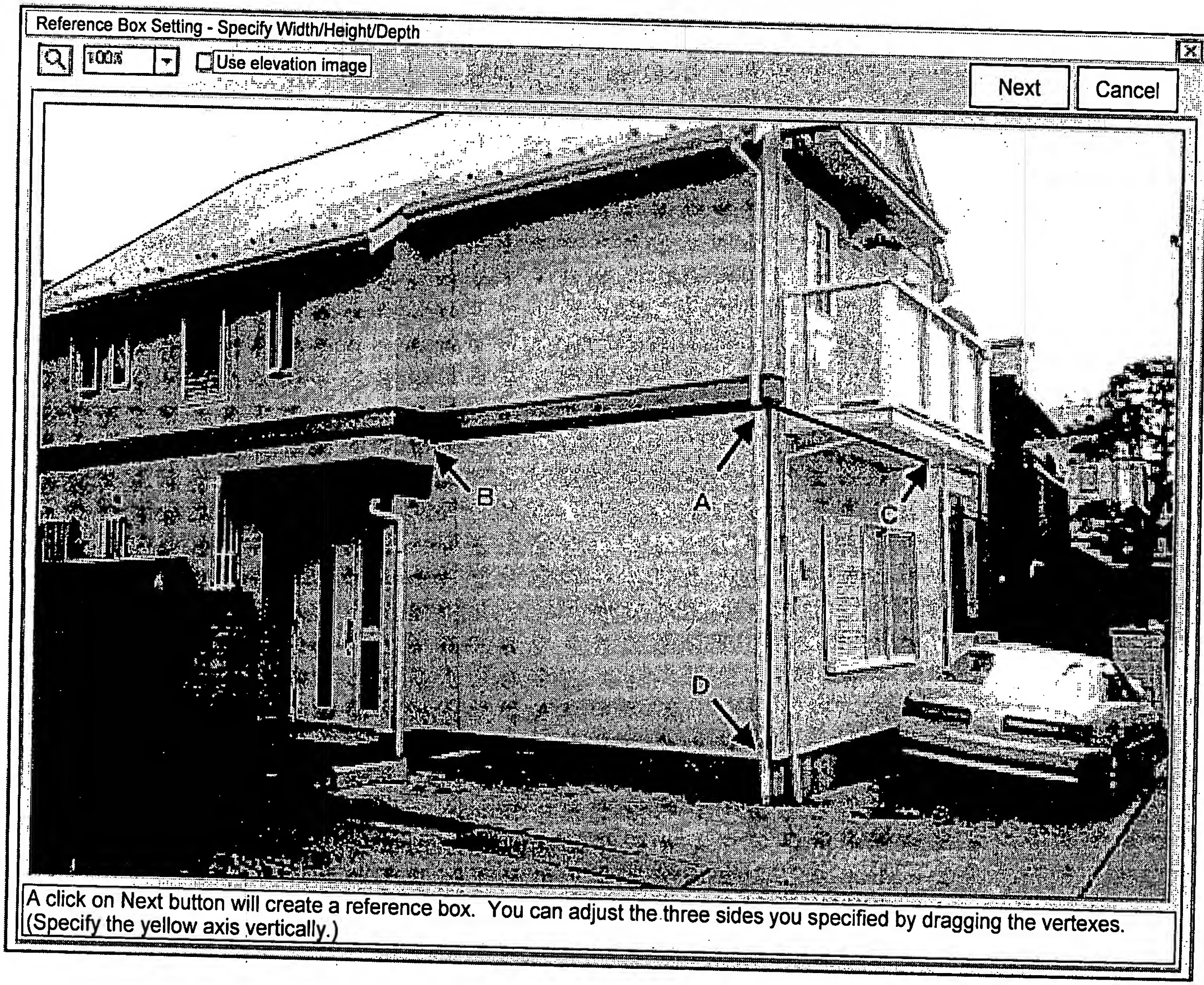
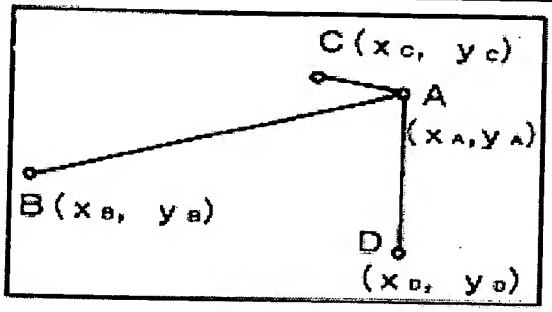

Reference Box Setting - Specify Width/Height/Depth
100%
Use elevation image
Next
Cancel
B
A
C
D
A click on Next button will create a reference box. You can adjust the three sides you specified by dragging the vertexes.
(Specify the yellow axis vertically.)

FIG.8



f: value corresponding to a focal length

Z_A: initial value

In an actual 3D space, AB and AC, AB and AD, and AC and AD will be each orthogonal to one another.

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \frac{Z}{f}\begin{pmatrix} x \\ y \\ f \end{pmatrix} \quad \cdots (1)$$

$$\left.\begin{array}{l} \overrightarrow{AB} \cdot \overrightarrow{AC} = 0 \ \text{(inner product is 0)} \\ \left[\frac{Z_B}{f}\begin{pmatrix} x_B \\ y_B \\ f \end{pmatrix} - \frac{Z_A}{f}\begin{pmatrix} x_A \\ y_A \\ f \end{pmatrix}\right] \cdot \left[\frac{Z_C}{f}\begin{pmatrix} x_C \\ y_C \\ f \end{pmatrix} - \frac{Z_A}{f}\begin{pmatrix} x_A \\ y_A \\ f \end{pmatrix}\right] = 0 \end{array}\right\} (2)$$

Similarly,

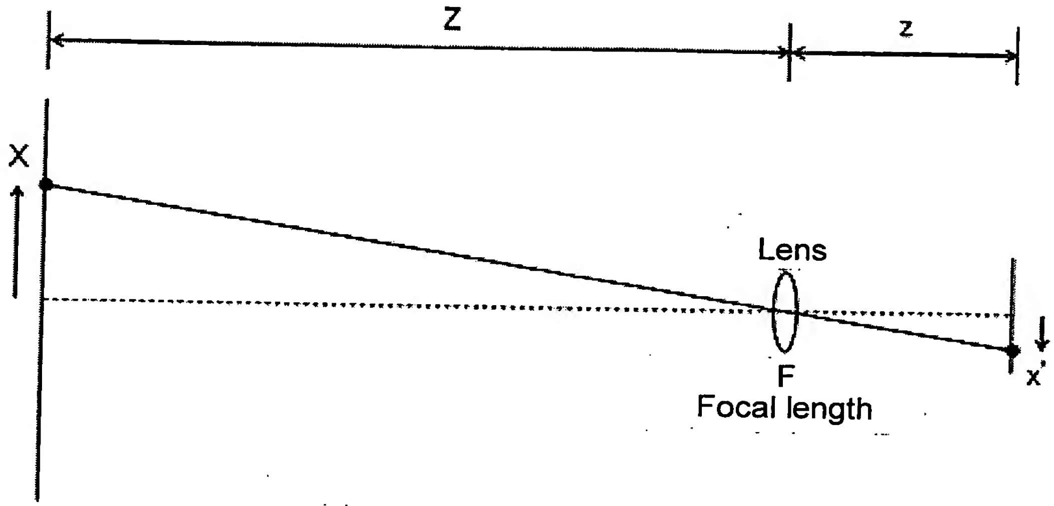
$$\overrightarrow{AB} \cdot \overrightarrow{AD} = 0 \quad \cdots (3)$$

Similarly,

$$\overrightarrow{AC} \cdot \overrightarrow{AD} = 0 \quad \cdots (4)$$

Unknowns Z_B, Z_C, and Z_D are determined from the three equations (2), (3) and (4) and the values are substituted to the equation (1).

FIG.9



LENS EQUATION

$$\frac{1}{Z}+\frac{1}{z}=\frac{1}{F} \longrightarrow z=\frac{F*Z}{Z-F}$$

$$\frac{x'}{X}=\frac{z}{Z}=\frac{F}{Z-F}\fallingdotseq\frac{F}{Z}$$

$$X=\frac{Z}{F}*x' \qquad Y=\frac{Z}{F}*y'$$

The number of pixels/Film width=x/x'

The number of pixels/Film width=y/y'

$$X=\frac{Z}{f}*x \qquad Y=\frac{Z}{f}*y$$

FIG.10

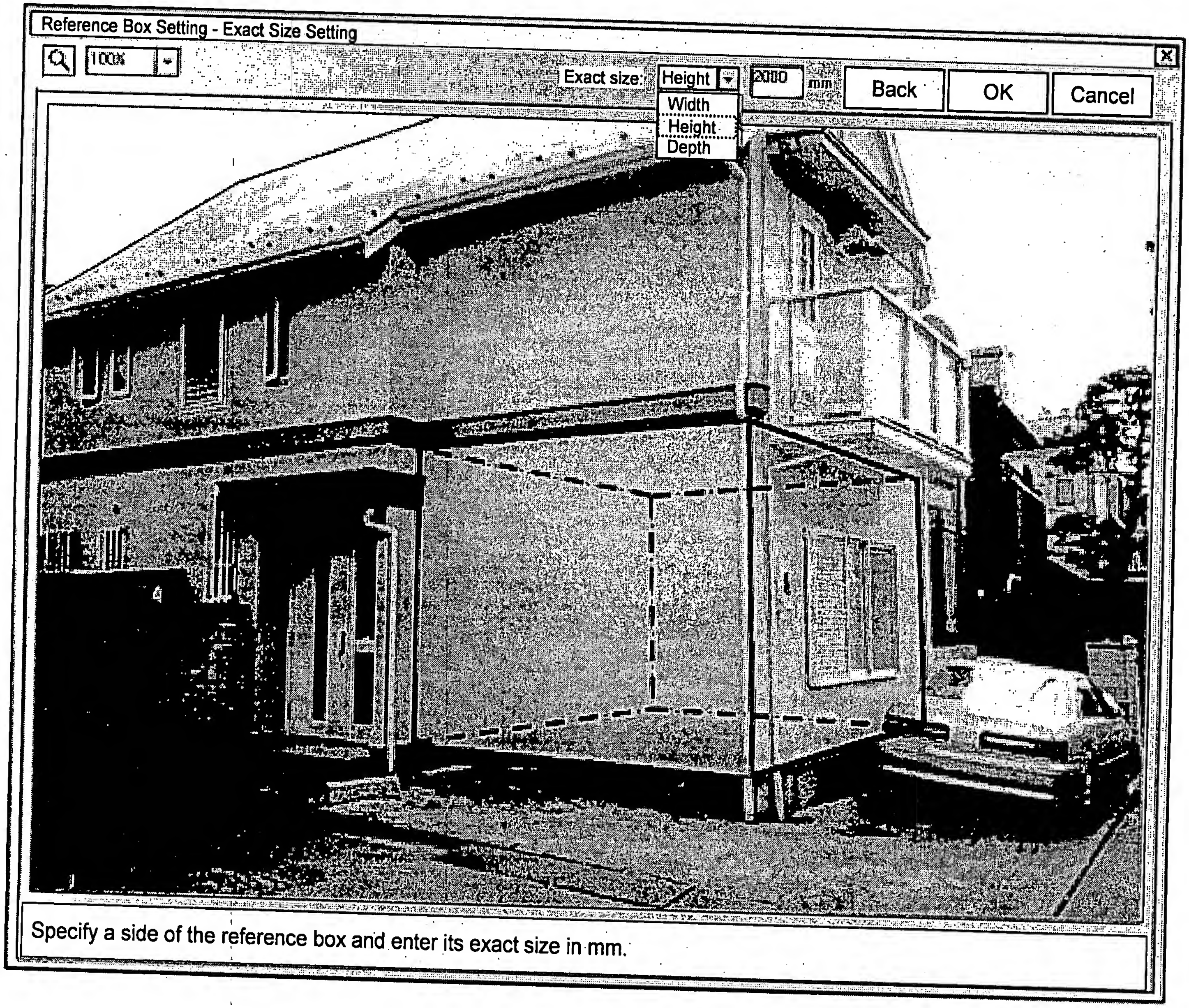

Reference Box Setting - Exact Size Setting
100%
Exact size:
Height
Width
Height
Depth
2000
mm
Back
OK
Cancel
Specify a side of the reference box and enter its exact size in mm.

FIG.11

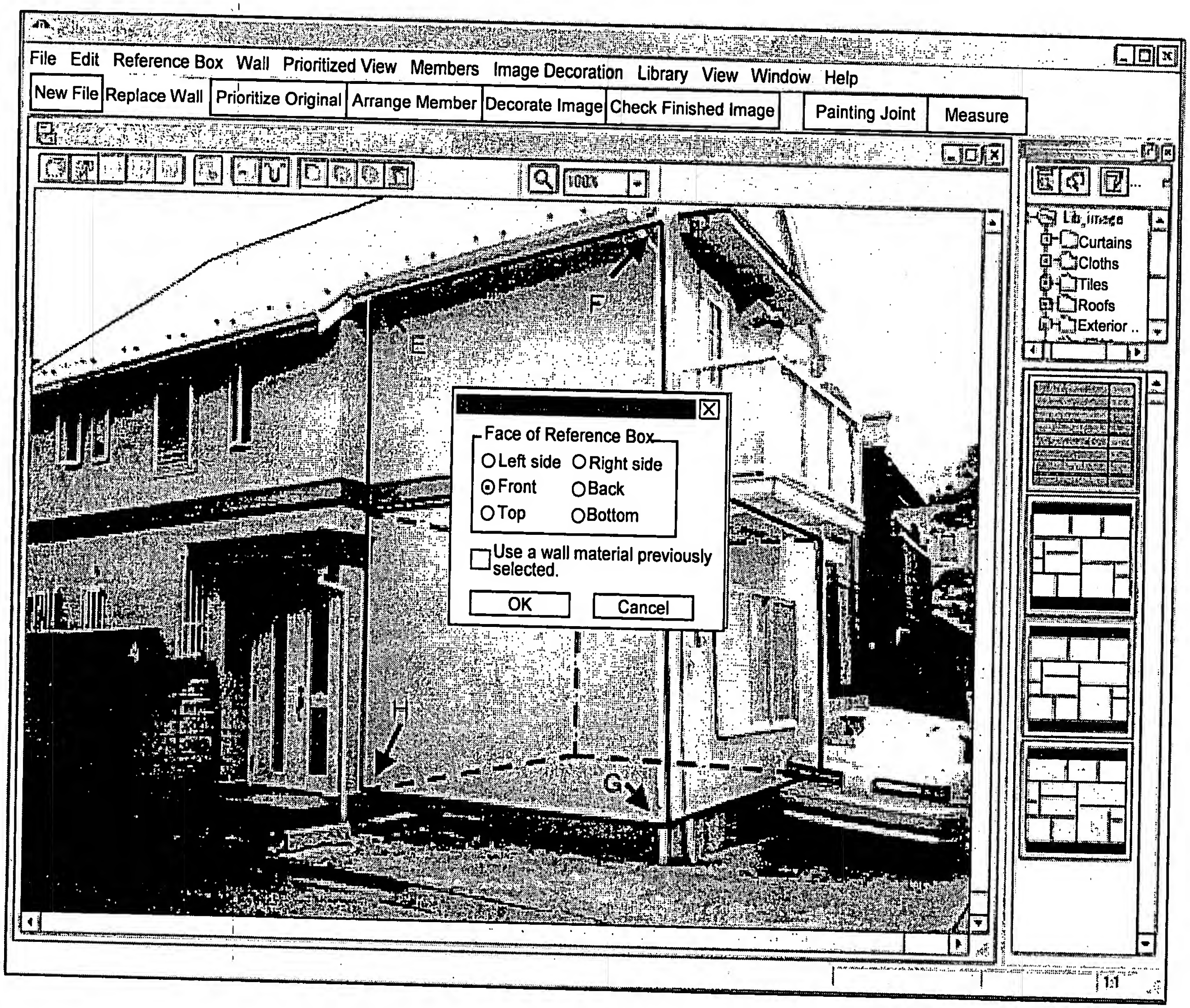


FIG.12

BEST AVAILABLE COPY

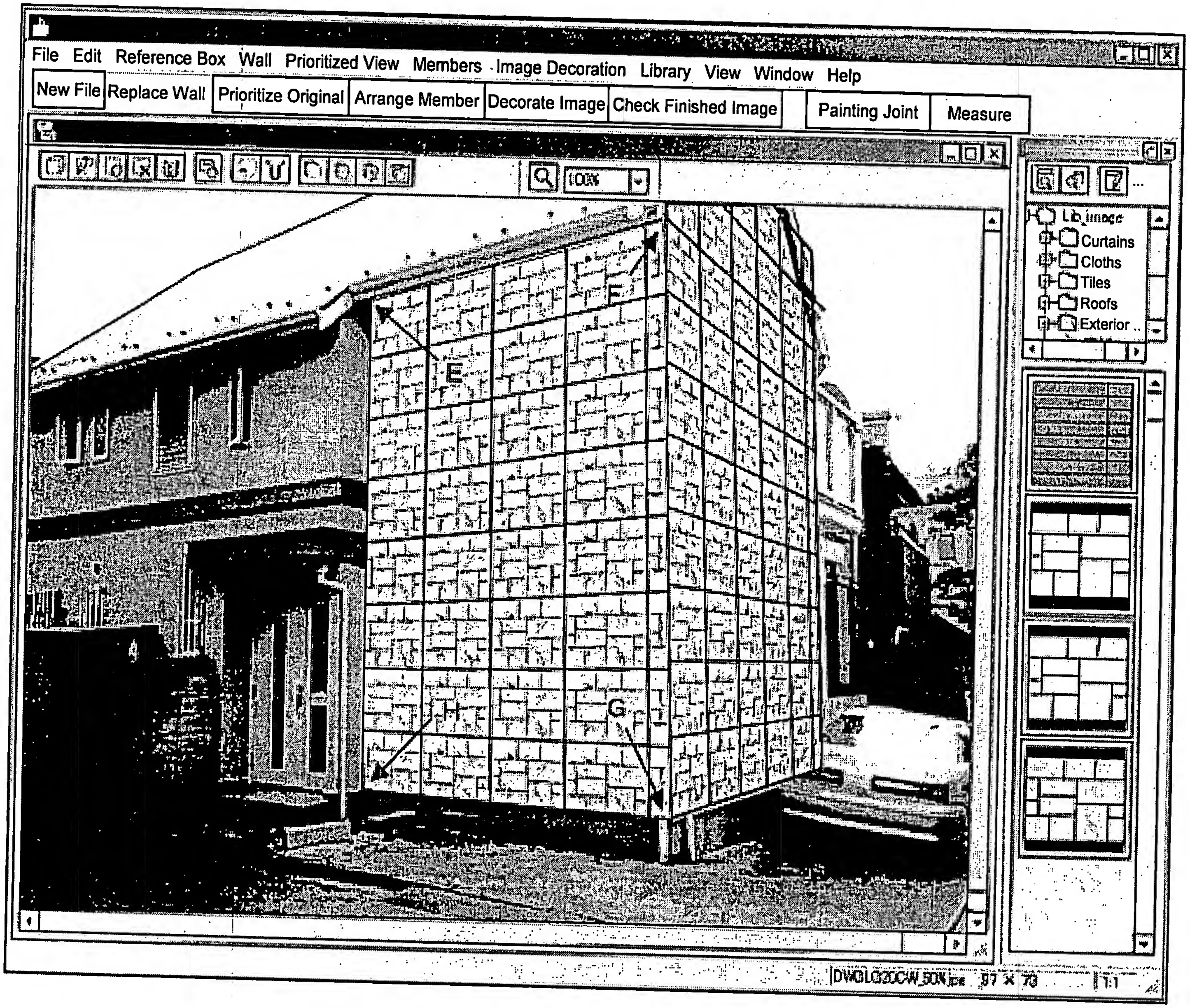

File Edit Reference Box Wall Prioritized View Members Image Decoration Library View Window Help
New File
Replace Wall
Prioritize Original
Arrange Member
Decorate Image
Check Finished Image
Painting Joint
Measure
100%
E
F
G
Lib_image
Curtains
Cloths
Tiles
Roofs
Exterior ..
1:1

FIG.13

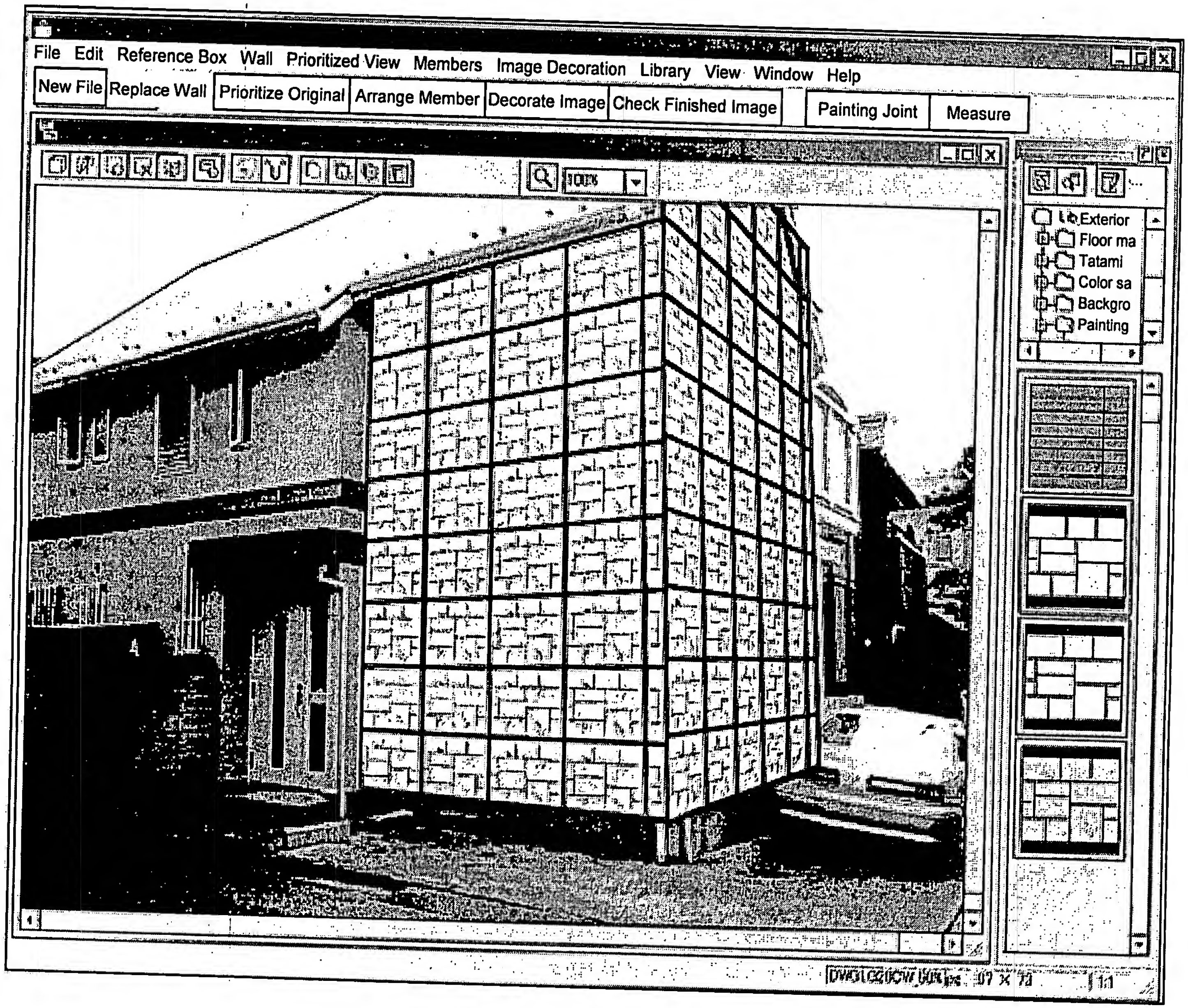

File Edit Reference Box Wall Prioritized View Members Image Decoration Library View Window Help
New File
Replace Wall
Prioritize Original
Arrange Member
Decorate Image
Check Finished Image
Painting Joint
Measure
Exterior
Floor ma
Tatami
Color sa
Backgro
Painting

FIG.14

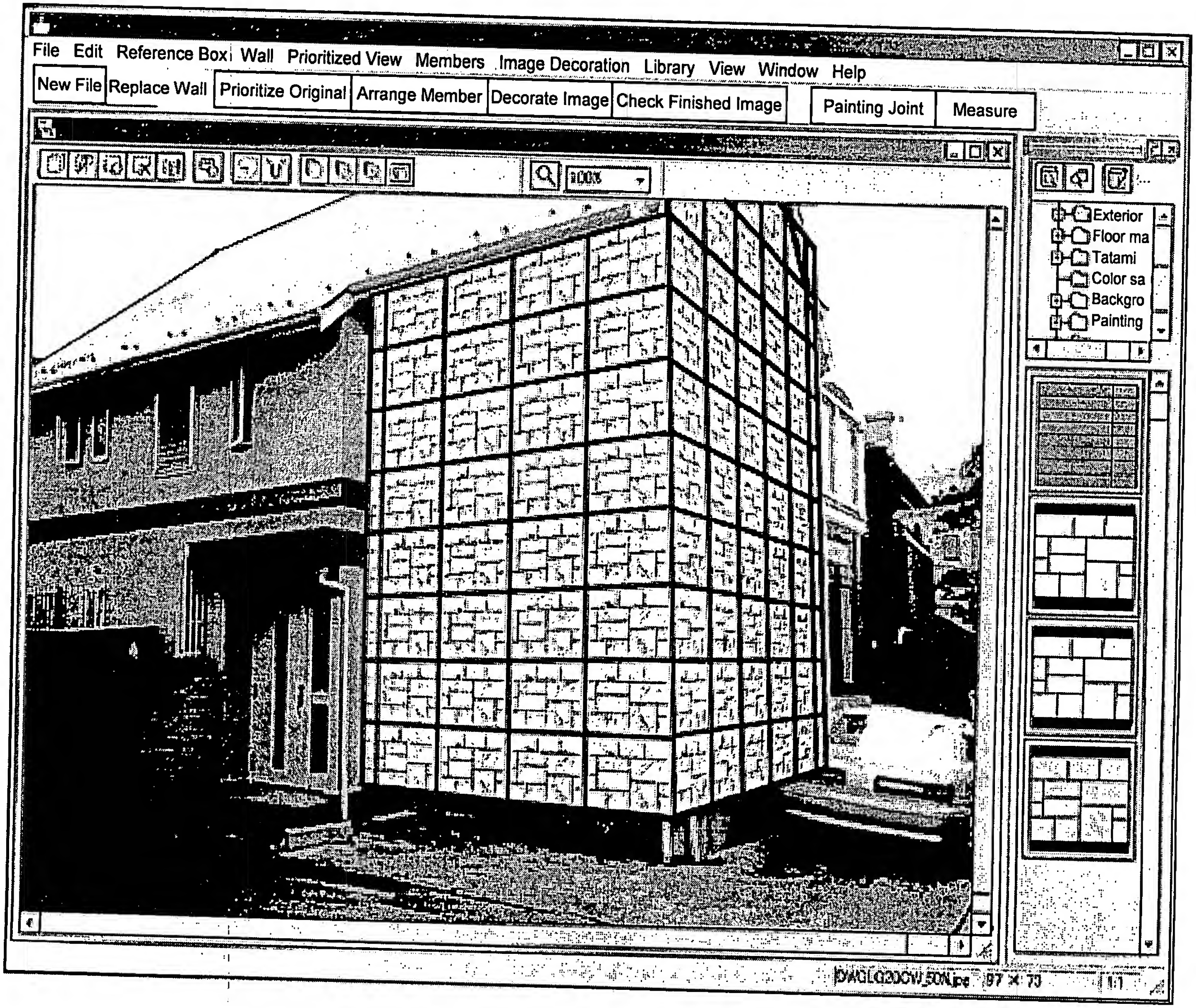


FIG.15

BEST AVAILABLE COPY

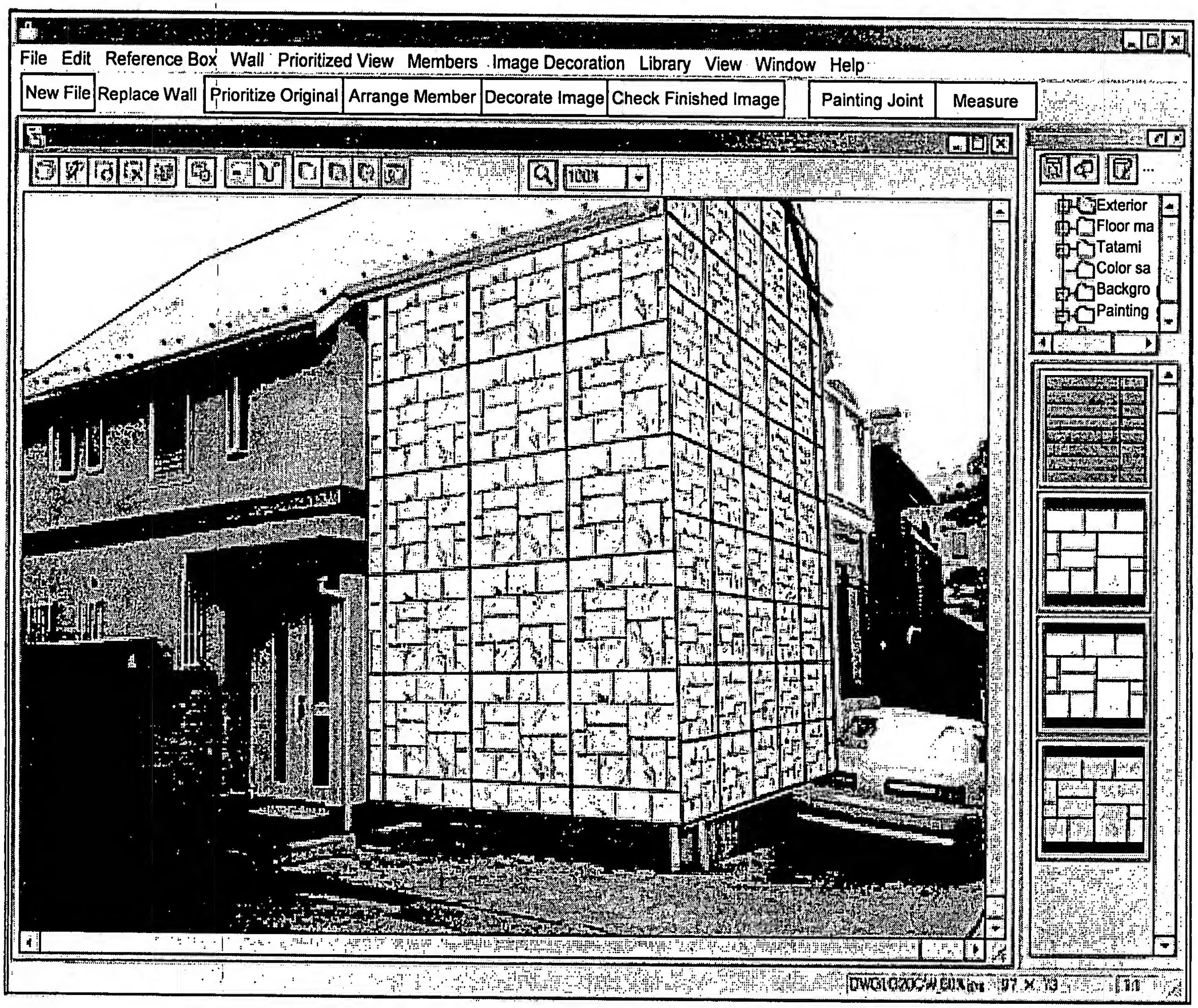

File Edit Reference Box Wall Prioritized View Members Image Decoration Library View Window Help
New File
Replace Wall
Prioritize Original
Arrange Member
Decorate Image
Check Finished Image
Painting Joint
Measure
Exterior
Floor ma
Tatami
Color sa
Backgro
Painting

FIG.16

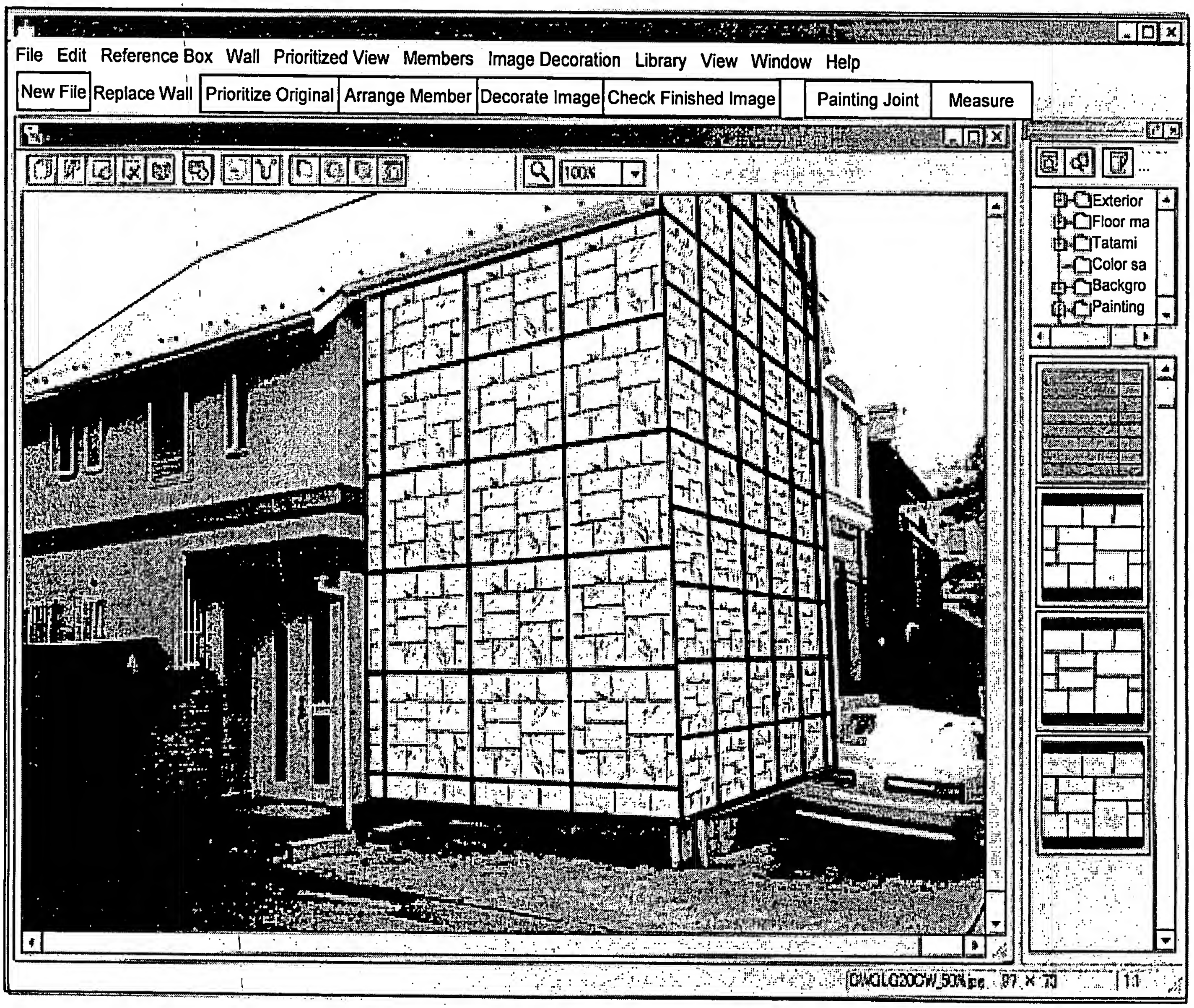


FIG.17

BEST AVAILABLE COPY